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ICESat Observations of Topographic Change in the Northern Segment of the 2004 Sumatra-Andaman Islands Earthquake Rupture Zone

Harding, D, Sauber, J, Luthcke, S, Carabajal, C, Muller, J

The Andaman Islands are located 120 km east of the Sunda trench in the northern quarter of the 1300 km long rupture zone of the 2004 Sumatra-Andaman Islands earthquake inferred from the distribution of aftershocks. Initial field reports indicate that several meters of uplift and up to a meter of submergence occurred on the western and eastern shorelines of the Andaman Islands, respectively, associated with the earthquake (Bilham, 2005). Satellite images also document uplift of western shoreline coral reef platforms above sea level. Body-wave (Ji, 2005; Yamamaka, 2005) and tide-gauge (Ortiz, 2005) slip inversions only resolve coseismic slip in the southern one-third to one-half of the rupture zone. The amount of coseismic slip in the Andaman Islands region is poorly constrained by these inversions. The Ice, Cloud, and land Elevation Satellite (ICESat), a part of the NASA Earth Observing System, is being used to document the spatial pattern of Andaman Islands vertical displacements in order to constrain models of slip distribution in the northern part of the rupture zone. ICESat carries the Geoscience Laser Altimeter System (GLAS) that obtains elevation measurements from 80 m diameter footprints spaced 175 m apart along profiles. For surfaces of low slope, single-footprint absolute elevation and horizontal accuracies of 10 cm and 6 m (1 sigma), respectively, referenced to the ITRF 2002 TOPEX/Poseidon ellipsoid are being obtained. Laser pulse backscatter waveforms enable separation of ground topography and overlying vegetation cover. During each 33-day observing period ICESat acquires three profiles crossing the Andaman Islands. A NNE-SSW oriented track consists of 1600 laser footprints along the western side of North, Middle, and South Andaman Islands and 240 laser footprints across the center of Great Andaman Island. Two NNW-SSE tracks consist of 440 footprints across Middle Andaman Island and 25 footprints across the west side of Sentinel Island. Cloud-free profiles were acquired in the fall of 2003 and 2004. During February-March, 2005 ICESat's precise pointing capability will be used to exactly repeat these three profiles, with a cross-track accuracy of better than 100 m, providing trench-parallel and -perpendicular observations of topographic change of the Andaman Islands that will compliment geodetic field surveys. The observed elevation changes will be compared to models of coseismic deformation associated with the mainshock and large aftershocks in the Andaman Islands region.